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NRL Memorandum Report 1607

Use of a Sailing Catamaran
as a Research Platform

[Unclassified Title]

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*Techniques Branch
Sound Division*

May 7, 1965

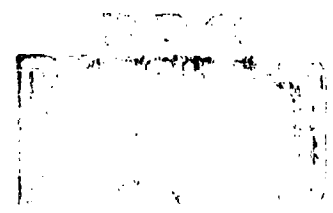
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ABSTRACT
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Some of the ocean-based research being performed by the U.S. Naval Research Laboratory personnel has resulted in the need for a research platform that introduces a minimum amount of disturbance into the ocean surface while measuring and sampling sea-water. With minor modifications, a 25-ft sailing catamaran has been made into a suitable manned research platform. Sampling runs made in the wake of a 50-ft submarine are described in detail.

PROBLEM STATUS

This is an interim report; work on this problem is continuing.

AUTHORIZATION

NRL Problem S01-18
ONR Project RF 101-03-44-4065
BUWEPS RUDC-4B-000/652-1/F001-99-01

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USE OF A SAILING CATAMARAN
AS A RESEARCH PLATFORM

INTRODUCTION

The purpose of this problem is to investigate the mechanisms involved in environmental effects caused by the presence of a submarine in order to develop devices that will further Navy capability in local detection and classification of a submarine target. Open-sea experiments have been carried out in order to measure the interaction of a moving submerged submarine with the physical, chemical, and biological characteristics of the ocean in the vicinity of the submarine track. In previous work (1,2), measurements were made of changes in local sea-water characteristics due to submarine motion. The measurements required sampling containers and techniques that would get uncontaminated volumes of sea water (3,4). In other ocean experiments (5,6), samples of surface and subsurface water were collected with special care to minimize sampling disturbance or contamination of the sea water. The surface and near-surface water was analyzed for changes in physical, chemical, or biological properties due to the effect of energies emitted by a moving submarine. Other experimental observations show that an effect exists (7), but there is still a need to determine the basic mechanisms involved. Once these mechanisms are understood, optimum equipment can be designed to perform the detection, short-range localization, and classification tasks.

BACKGROUND

Some of the possible mechanisms investigated (8,9), that would couple a submarine's energy to the sea surface or near surface, are hydrodynamic and sonic. In the hydrodynamic case the submarine could push small quantities of water from its operating depth into the surface layers. In the sonic case organisms located in or near the sea surface appear to act as backscatterers and absorbers of the acoustic energy emitted by a submarine. The energy emitted by a submarine decreases

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with distance, and interaction with surface water is relatively weak. In many of these experiments, the measurements and samples are taken in the surface water above the track of a submarine and compared with measurements made in undisturbed water at a distance from the submarine track. Highly sensitive and accurate sampling and measuring techniques are required in these efforts to use the ocean itself as a detector of submarines by determining the mechanisms involved in changes in the characteristics of sea-water. To achieve this accuracy there must be a minimum of physical and chemical disturbance of the surface water during the sampling and measuring process. In addition, the support vehicle must be compatible with the sampling operation; also needed is sufficient working space for personnel, instruments, and equipment, vehicle seaworthiness, maneuverability, and effective radius of action.

The use of surface ships for surface sampling is not compatible with the preceding criteria. Ships' propellers add large amounts of energy to the near-surface water. Considerable amounts of oil and other contaminants are added to the water by the bilge pumps and organic material sloughing off the hull. When a ship lies to, a visible film of oil will spread from the ship to a distance of 500 yards or more, depending on sea and weather conditions. If sampling buoys are used, there is the problem of measuring the amount of energy put in by the method of sea-water intake. Pumping or vacuum methods used in these buoys put energy into the water sample, modifying to some extent the sample characteristics. In order to reduce the possibility of extraneous material or energy being added to the water samples, other techniques are necessary.

There is an increased probability of acquiring samples without substantial contamination by utilizing a research platform carrying men who are aware of the sampling and measuring problems, who have the necessary experience and knowledge, and who can directly observe and control the experimental processes. With suitable additions of structure and equipment, a sailing catamaran provides a manned research platform meeting this need for a minimum-interference vehicle more nearly compatible with low-noise-

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level surface and near-surface sampling or measuring techniques. The catamaran twin-hull design affords a stable level platform close to the water surface with sufficient deck room for personnel to carry out experiments. The narrow, minimum-wetted-surface hulls introduce very little bow wave and wake. The use of sails for propulsion eliminates the addition of propeller turbulence, oil, and motor exhaust to the ocean surface, while providing the capability of ranging over a large area. The catamaran that is presently being used is low in weight, folds onto a trailer, and is easily transported. It can be carried aboard a ship to an ocean operating area, and it can be put over the side and retrieved by a ship's crane. The boat can also be towed by a ship in a paravane fashion, putting it well outside of the ship's wake. The hull surface, with a chemically inert polyurethane coating, can readily be kept clean to prevent adding contaminants in the vicinity of the catamaran.

DESCRIPTION OF THE CATAMARAN

The catamaran work space (Fig. 1) is divided into two areas. The aft area is used for minor equipment and is primarily a personnel working space. Most of the equipment is kept forward of the center strut during an experimental run. To assist in going to and returning from the experimental work area, a long-shaft outboard motor is housed next to the forward section of the starboard hull. It is kept wrapped in polyvinyl sheeting during sampling operations to prevent any oil or other contaminating material from reaching the water. The center opening is 3 x 3 ft immediately forward of the mast. Two 3/8-in. plywood planks 1-1/2 x 3 ft in size are used to cover this opening. Both or one can be removed, to give direct access to the surface of the water, approximately 18 in. below. Measuring instruments fastened on identical planks can be simply mounted on and demounted from this opening. Usually one-half of the centerwell is left open to facilitate observation and adjustment of the portion of the instrument that is in the water. As illustrated in Figs. 1, 2, and 3, floats, sampling bottles, and auxiliary equipment are put in the forward area in order to keep the aft deck clear for personnel. Heavy loads are kept close to the center strut

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in order to be sure that the catamaran ends are kept buoyant. This arrangement allows the craft to ride the tops of the waves and keeps the deck dry. Appendix A contains a description of the catamaran characteristics.

DESCRIPTION OF SURFACE SAMPLERS

Five-gallon polyethylene carboys suitably modified (3) were used as surface samplers. Figures 4 and 5 are photographs of a typical sampler. The rectangular wood collar changes the location of the center of gravity of the bottle. This collar keeps the mouth of the bottle at the water surface while it fills, with the waterline staying approximately at the diameter of the mouth during the filling operation while the bottle rotates about a diameter across the mouth of the bottle as an axis. The bottle starts in a tipped position, with the mouth in the water, and as it gradually fills it rotates into an upright position. Filling time is about five minutes. The slow intake and absence of splashing provides a minimum disturbance of the surface and near-surface water.

TESTS

The principal tests of the use of a catamaran as a research platform were conducted during four separate weeks in June and July 1964, in the Chesapeake Bay. A 50-ft Navy submarine, the SSX-1, and its tender, an 83-ft YP (654) were the other vehicles in the operation. Figure 6 illustrates the submarine runs. The YP would take station about 2000 yds downwind from the surfaced submarine. The catamaran would move from point I to point II, placing the flag buoys in a line in order to provide a bearing for the submarine. The submarine would dive at point III, run under the flag buoys, and surface 200 yds past the YP. The flag buoys were used as markers of the submarine track. Surface sampling bottles were placed in and out of the track (Fig. 6). After the bottles had filled, they were retrieved by the catamaran and returned to the YP. To keep surface disturbance to a minimum while placing the samplers in the water, the catamaran was brought up into the wind at each sampling location, the samplers were placed in the water off the windward bow, and the boat was allowed to drift away gradually in order not to disturb the intake water area. Figures 7, 8, and 9,

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show the catamaran in operation. During the period of operations, the wind varied from less than five knots to 18 knots. Each complete run took from three-quarters of an hour to one hour, according to wind conditions. In light winds of two knots or less, fewer samples could be taken in the prescribed time. With winds of 20 knots or more, wave conditions precluded effective sampling, since conditions were too rough for a low-disturbance intake of surface water. At 30-knot wind velocities, the catamaran could not be used as a research platform due to spray and water coming across the deck.

RESULTS

An analysis of the turbidity of the water samplers in and out of the submarine wake showed differences between the in-wake and out-of-wake water. The catamaran provided a stable research platform with minimum water disturbance and contamination occurring during its operation. It could easily be brought into position so that effective sampling could be accomplished. It handled well and had excellent maneuverability under a wide variety of operating conditions.

FUTURE PLANS

A sailing catamaran could be used as a continuous sampling platform by attaching water scoops at and below the water line of the hulls. A capillary wave and turbidity-measuring instrument is being designed for attachment to the forward strut of the catamaran.

RECOMMENDATIONS

The particular vehicle being used requires some modification to increase its operational capability; roller-reefing to allow for easier adjustment of the sail area, a quick-release device for the main sheet in gusty conditions, and a mast tabernacle to expedite setting up the mast and standing rigging would improve boat handling and reduce setting-up time.

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APPENDIX A

Catamaran Specifications

| | |
|-------------------------|-----------------------------|
| Length overall | 25 ft |
| Beam overall | 12 ft |
| Length on waterline | 22 ft 6 in |
| Weight of hull stripped | 450 lb |
| Design displacement | 920 lb |
| Working sail area | 240 ft ² |
| Length of mast | 33 ft 6 in. |
| Draft center board up | 8 in. |
| Draft center board down | 4 ft 6 in. |
| Freeboard, average | 16 in. |
| Working space | 200 ft ² approx. |

Boat loaded with 1200 lb will sink 2-1/2 in. below water line.

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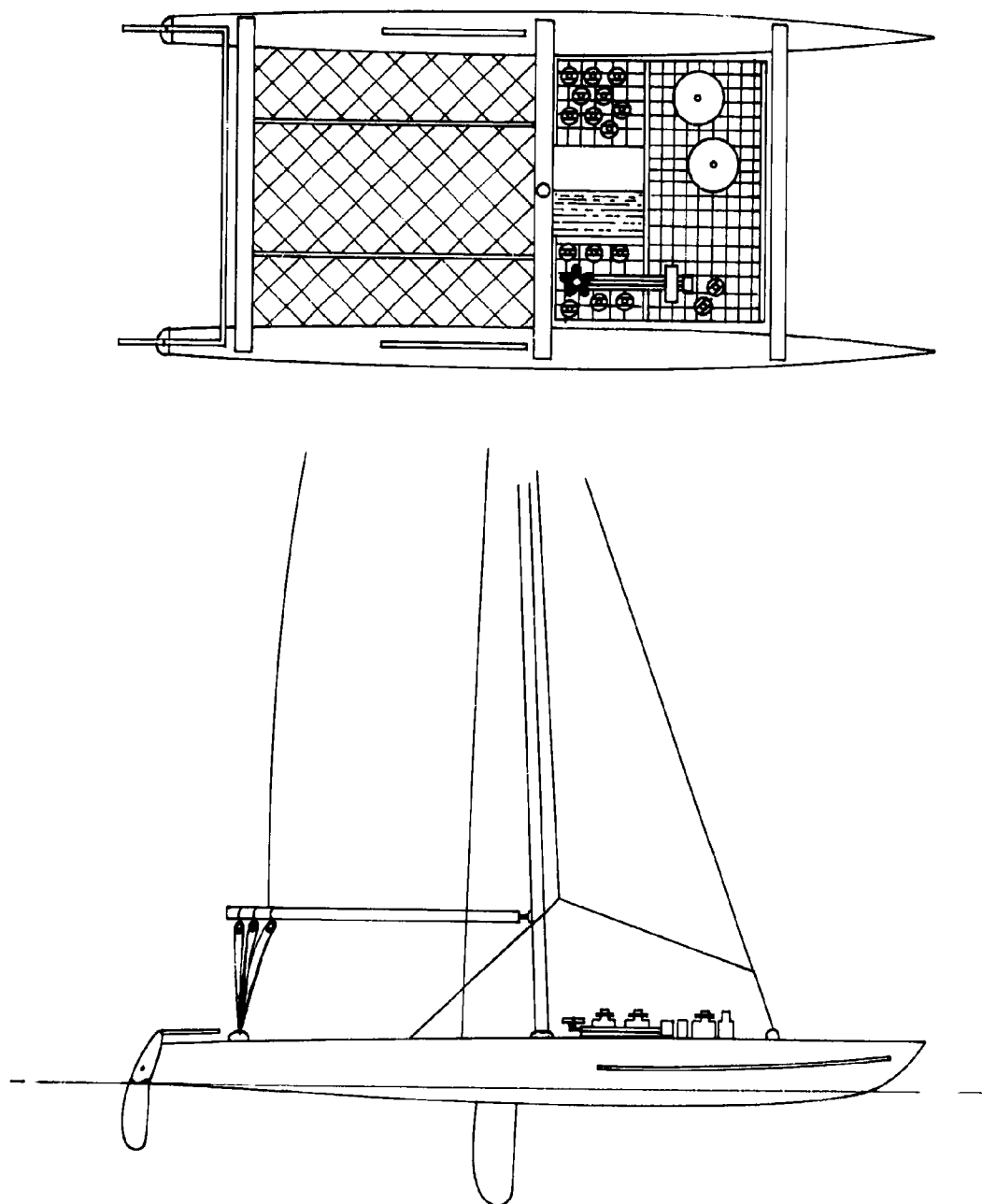


Fig. 1 - Plan view of catamaran, showing location
of sampling carboys and buoys

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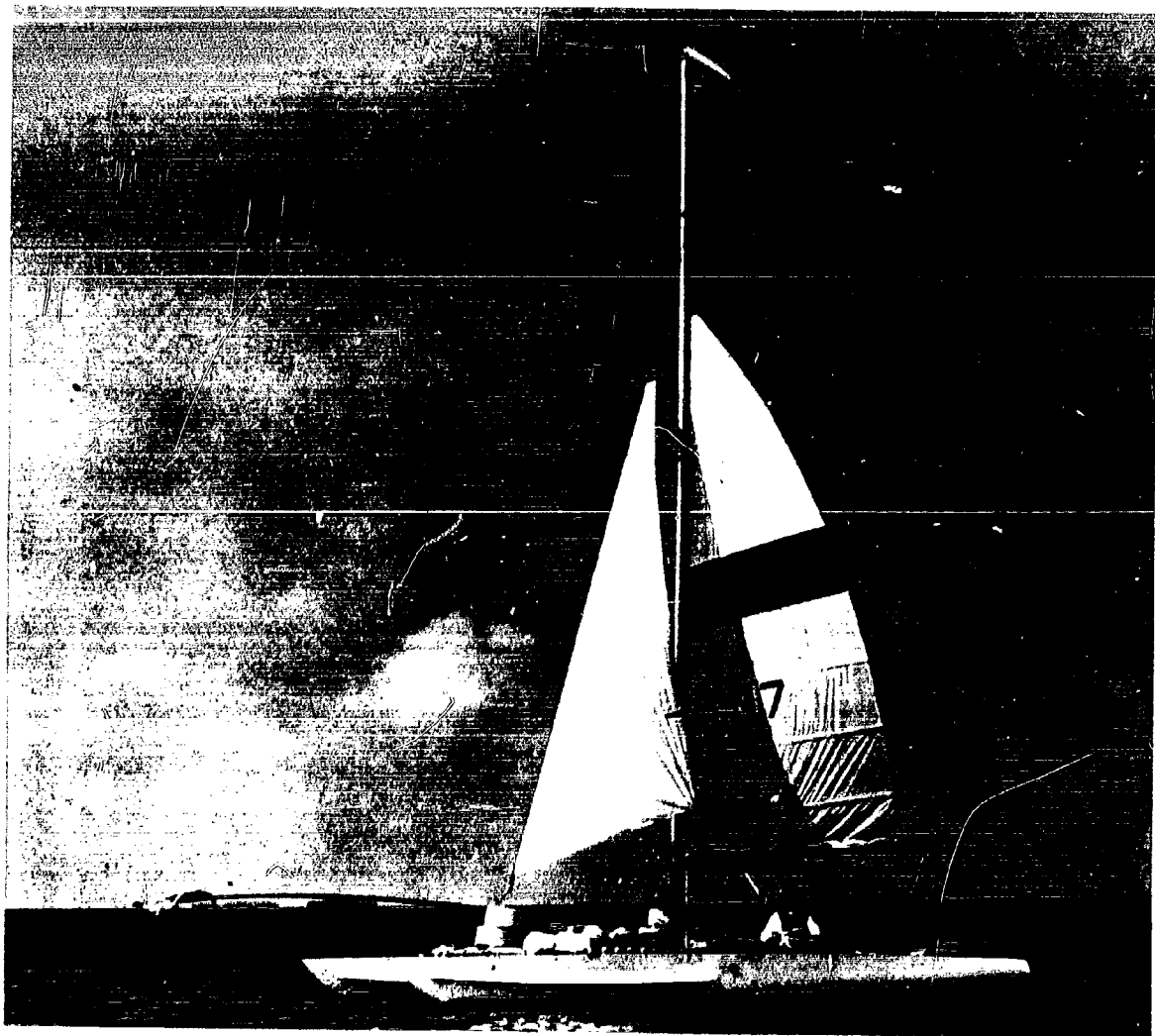


Fig. 2 - A side view of the catamaran, showing sampling bottles and flag buoys occupying the forward deck area. The main sail is reefed in the expectation of rising winds.

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Fig. 3 - A close-up of the deck space showing samplers and flag buoys

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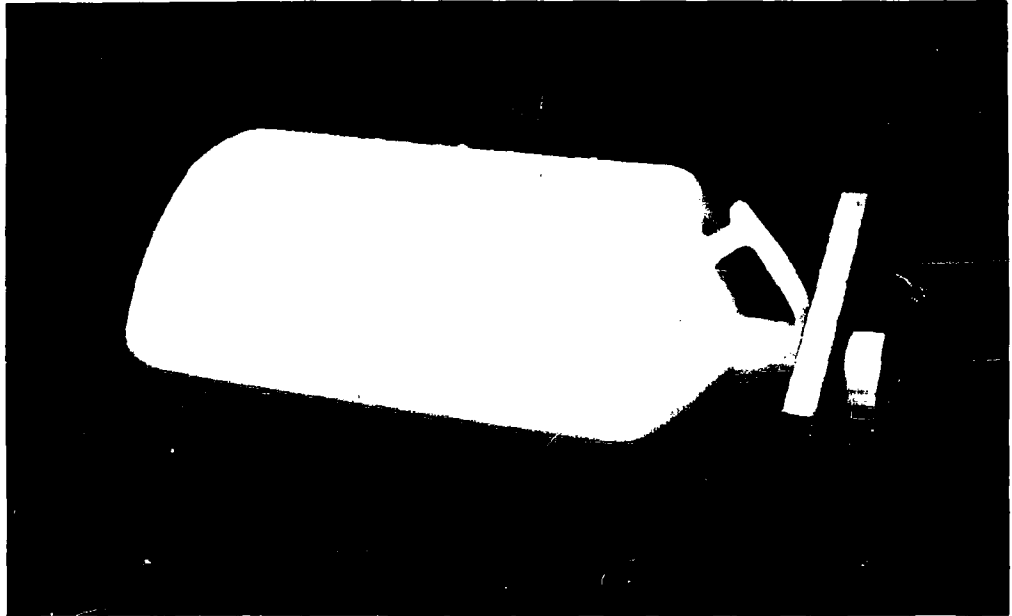


Fig. 4 - Polyethylene carboy sampler while filling with water

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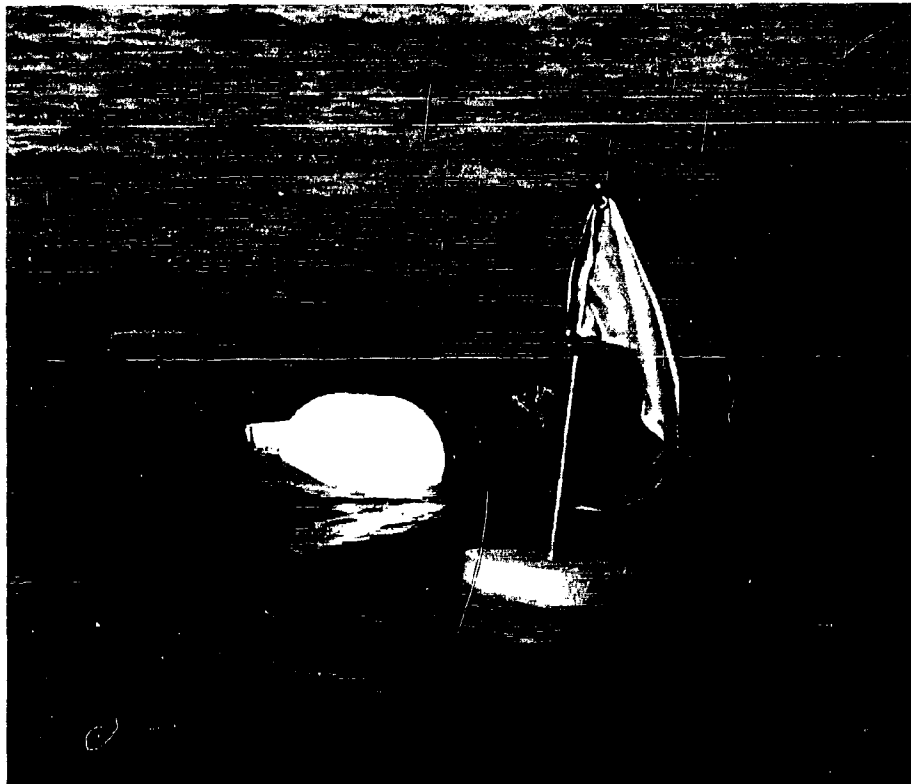


Fig. 5 - Another view of the 5-gallon polyethylene sampler as it begins to fill. The flag buoy acts as a marker to help in retrieval, since the fully filled carboy becomes completely immersed except for the rectangular block of wood floating on the surface.

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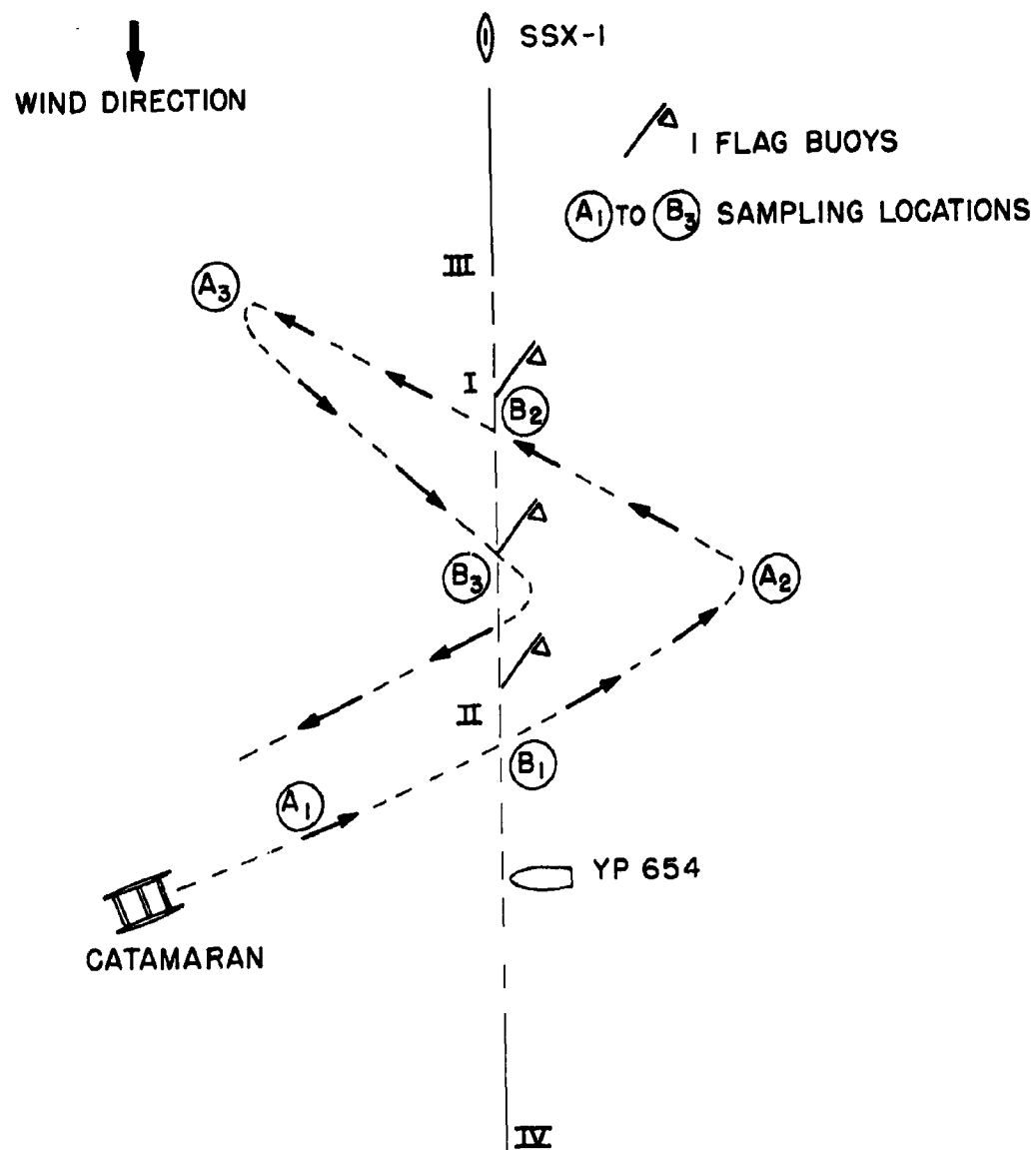


Fig. 6 - Drawing of operation as conducted in Chesapeake Bay. The SSX-1 starts its dive at III and surfaces at IV

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Fig. 7 - Photo illustrating the low level of water disturbance in the wake of the catamaran. The sampler has just been placed in the water.

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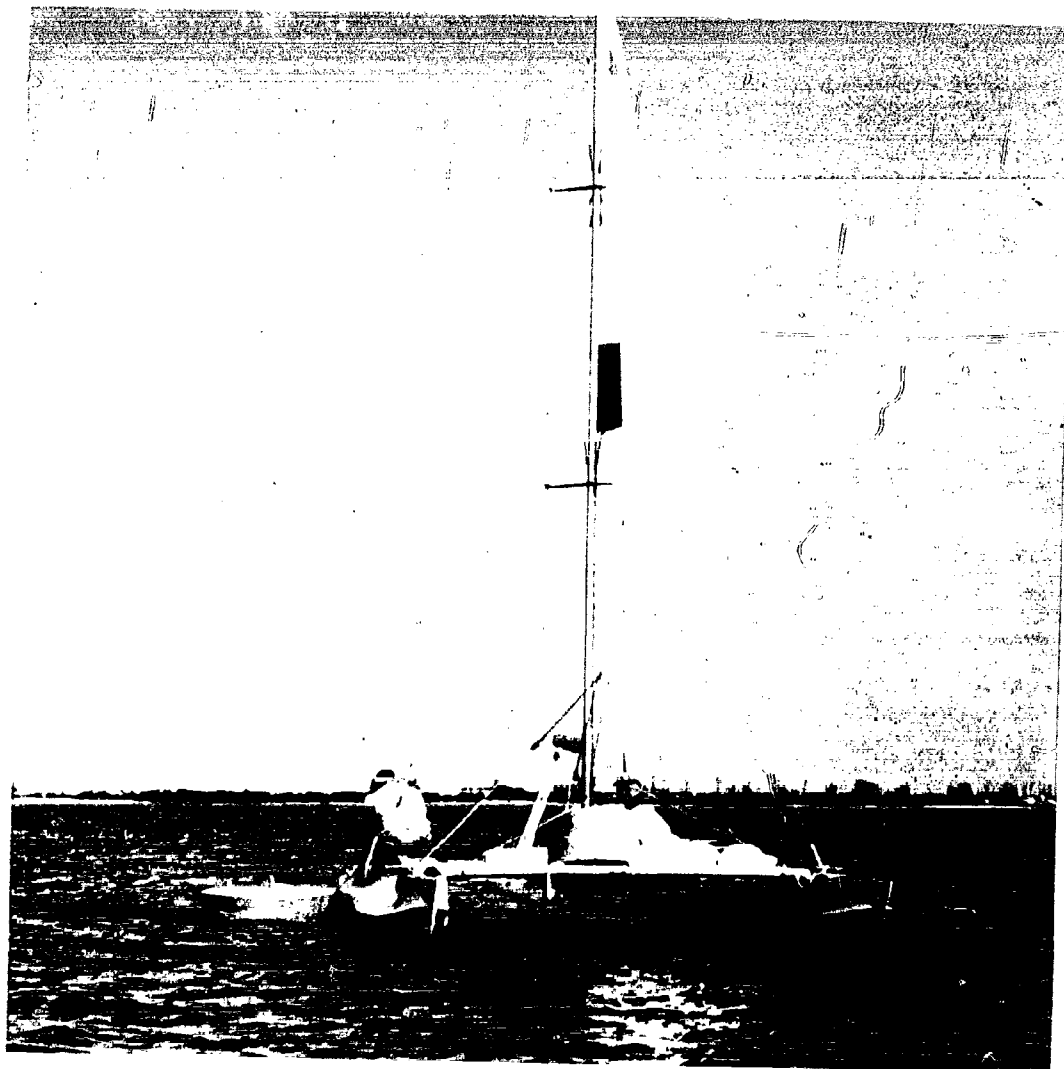


Fig. 8 - View showing the narrow hulls and the small bow-wave. The space between hulls facilitates placing instruments in undisturbed water with ready adjustment capability and excellent observability.

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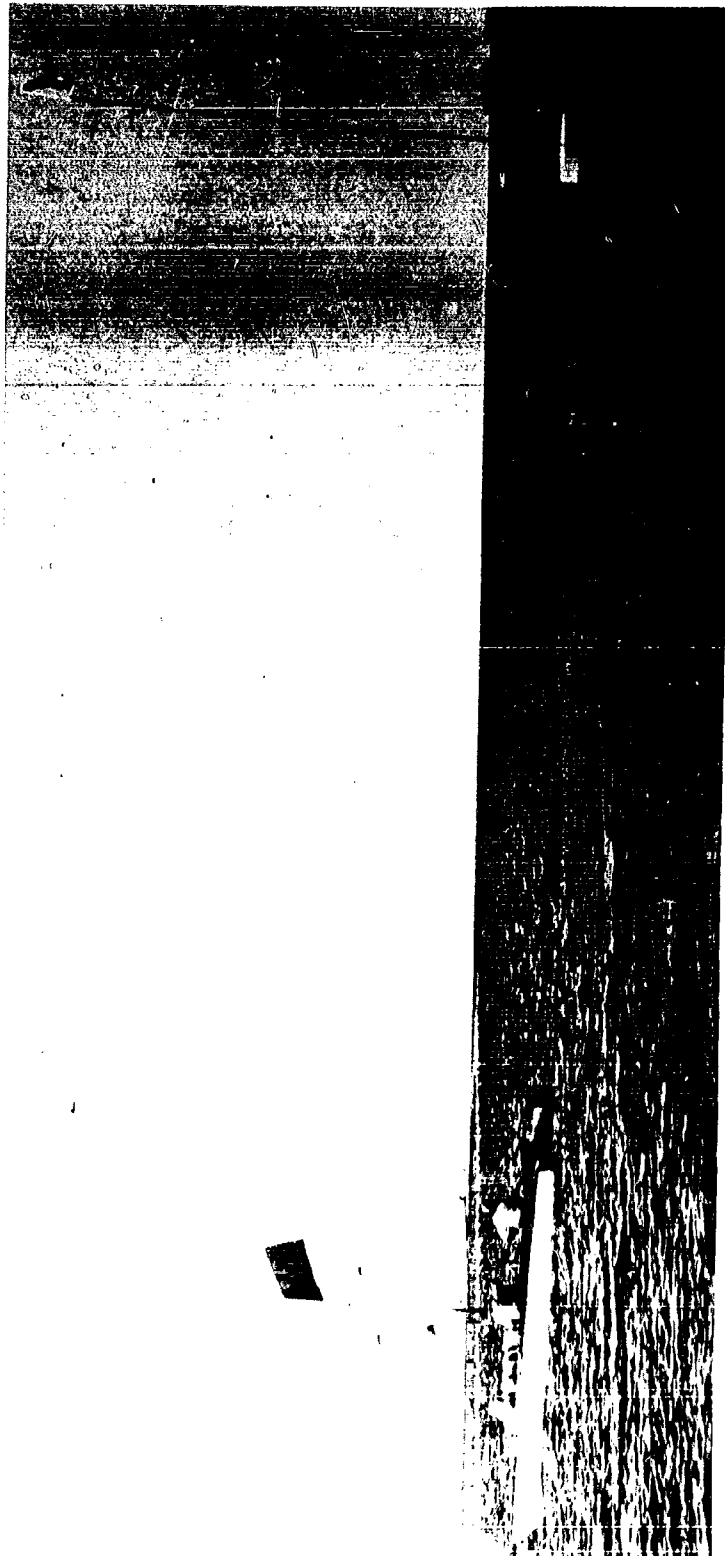


Fig. 9 - View showing the smallness of the wake after a marker buoy has been placed in position and the catamaran has pulled away

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UNITED STATES GOVERNMENT
Memorandum

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DATE: 10 September 2003

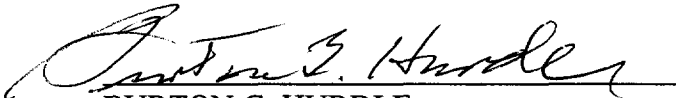
REPLY TO
ATTN OF: Burton G. Hurdle (Code 7103)

SUBJECT: REVIEW OF REF (A) FOR DECLASSIFICATION

TO: Code 1221.1

REF: (a) "Use of a Sailing Catamaran as a Research Platform" (U), W.B. Nefedov and R.C. Beckett, Sound Division, NRL Memo Report 1607, May 7, 1962 (C)

1. Reference (a) tests were conducted on a 25 ft sailing catamaran that was used in order to have minimum effect on disturbing the ocean surface. The tests were conducted in the Chesapeake Bay using the catamaran and the SSX-1 submarine in June and July 1964. The tests were conducted to determine the effect of a passing submarine on the water. The tests were scheduled to continue with some improvements to the catamaran.
2. The technology and equipment of reference (a) have long been superseded. The current value of these papers is historical.
3. Based on the above, it is recommended that reference (a) be declassified and released with no restrictions.


BURTON G. HURDLE
NRL Code 7103

CONCUR: Edward R. Franchi 9/11/2003
E.R. Franchi Date
Superintendent, Acoustics Division

CONCUR: Tina Smallwood 9/15/03
Tina Smallwood Date
NRL Code 1221.1